General

Guideline Title

Practice advisory for the perioperative management of patients with cardiac implantable electronic devices: pacemakers and implantable cardioverter-defibrillators. An updated report by the American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Cardiac Implantable Electronic Devices.

Bibliographic Source(s)

American Society of Anesthesiologists. Practice advisory for the perioperative management of patients with cardiac implantable electronic devices: pacemakers and implantable cardioverter-defibrillators: an updated report by the American Society of Anesthesiologists Task Force [trunc]. Anesthesiology. 2011 Feb;114(2):247-61. [81 references] PubMed

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Cardiac Rhythm Management Devices. Practice advisory for the perioperative management of patients with cardiac rhythm management devices: pacemakers and implantable cardioverter-defibrillators: a report by the American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Cardiac Rhythm Management Devices. Anesthesiology. 2005 Jul;103(1):186-98.

Recommendations

Major Recommendations

I. Preoperative Evaluation
   A. Establish whether a patient has a cardiac rhythm management device (CIED).
      1. Conduct a focused history (patient interview, medical records review, and review of available chest x-rays, electrocardiograms, or any available monitor or rhythm strip information).
      2. Conduct a focused physical examination (check for scars and palpate for device).
      3. Define the type of CIED.
         a. Obtain manufacturer's identification card from patient or other source.
         b. Order chest x-ray if no other data are available.
         c. Refer to supplemental resources (e.g., manufacturer's databases).
   B. Determine the dependence on pacing function of the CIED.
      1. Patient has history of symptomatic bradyarrhythmia resulting in CIED implantation.
      2. Patient has history of successful atrioventricular nodal ablation.

3. Patient has inadequate escape rhythm at lowest programmable pacing rate.

C. Determine CIED function.
   1. Interrogate device (consultation with a cardiologist or pacemaker-implantable cardioverter-defibrillator [ICD] service may be necessary).
   2. Determine whether the device will capture when it paces (i.e., produce a mechanical systole with a pacemaker impulse).
   3. Consider contacting the manufacturer for perioperative recommendations.

II. Preoperative Preparation
   A. Determine whether electromagnetic interference (EMI) is likely to occur during the planned procedure.
      1. Determine whether reprogramming pacing function to asynchronous mode or disabling rate responsive function is advantageous.
      2. Suspend antitachyarrhythmia functions if present.
      3. Advise the individual performing the procedure to consider use of a bipolar electrocautery system or ultrasonic (harmonic) scalpel.
      4. Temporary pacing and defibrillation equipment should be immediately available.
   B. Evaluate the possible effects of anesthetic techniques and of the procedure on CIED function and patient-CIED interactions.

III. Intraoperative Management
   A. Monitor operation of the CIED
      1. Conduct electrocardiographic monitoring per American Society of Anesthesiologists standard.
      2. Monitor peripheral pulse (e.g., manual pulse palpation, pulse oximeter plethysmogram, and arterial line).
      3. Manage potential CIED dysfunction as a result of EMI.
   B. Electrocautery
      1. Assure that the electrosurgical receiving plate is positioned so the current pathway does not pass through or near the CIED system. For some cases, the receiving plate might need to be placed on a site different from the thigh (e.g., the superior posterior aspect of the shoulder contralateral to the generator position for a head and neck case).
      2. Advise the individual performing the procedure to avoid proximity of the cautery's electrical field to the pulse generator or leads.
      3. Advise the individual performing the procedure to use short, intermittent and irregular bursts at the lowest feasible energy levels.
      4. Advise the individual performing the procedure to reconsider the use of a bipolar electrocautery system or ultrasonic (harmonic) scalpel in place of a monopolar electrocautery system if possible.
   C. Radiofrequency (RF) ablation
      1. Advise the individual performing the procedure to avoid direct contact between the ablation catheter and the pulse generator and leads.
      2. Advise the individual performing the procedure to keep the RF's current path as far away from the pulse generator and lead system as possible.
   D. Lithotripsy
      1. Advise the individual performing the procedure to avoid focusing the lithotripsy beam near the pulse generator.
      2. If the lithotripsy system triggers on the R-wave, consider preoperative disabling of atrial pacing.
   E. Magnetic resonance imaging
      1. MRI is generally contraindicated in patients with CIEDs.
      2. If an MRI must be performed, consult with the ordering physician, the patient's cardiologist, the diagnostic radiologist, and the CIED manufacturer.
   F. Radiation therapy
      1. Radiation therapy can be safely performed in patients who have CIEDs.
      2. Surgically relocate the CIED if the device will be in the field of radiation.
   G. Electroconvulsive therapy
      1. Consult with the ordering physician, the patient's cardiologist, a CIED service, or the CIED manufacturer.
   H. Emergency defibrillation or cardioversion
      1. For the patient with an ICD and magnet-disabled therapies:
         a. Advise the individual performing the procedure to terminate all sources of EMI while the magnet is removed.
         b. Remove the magnet to reenable antitachycardiac therapies.
         c. Observe the patient and the monitors for appropriate CIED therapy.
         d. If the above activities fail to restore ICD function, proceed with emergency external defibrillation or cardioversion.

2. For the patient with an ICD and programming-disabled therapies:
    a. Advise the individual performing the procedure to terminate all sources of EMI while the magnet is removed.
    b. Re-enable therapies through programming if the programmer is immediately available and ready to be used.
    c. Observe the patient and the monitors for appropriate CIED therapy.
    d. If the above activities fail to restore ICD function, proceed with emergency external defibrillation or cardioversion.
3. For external defibrillation:
    a. Position defibrillation/cardioversion pads or paddles as far as possible from the pulse generator.
    b. Position defibrillation/cardioversion pads or paddles perpendicular to the major axis of the CIED to the extent possible by placing them in an anterior-posterior location.
    c. If it is technically impossible to place the pads or paddles in locations that help to protect the CIED, then defibrillate/cardiovert the patient in the quickest possible way and be prepared to provide pacing through other routes.
    d. Use a clinically appropriate energy output.

IV. Postoperative Management
    A. Continuously monitor cardiac rate and rhythm and have back-up pacing and defibrillation equipment immediately available throughout the immediate postoperative period.
    B. Interrogate and restore CIED function in the immediate postoperative period.
        1. Interrogate CIED; consultation with a cardiologist or pacemaker-ICD service may be necessary.
        2. Restore all antitachyarrhythmic therapies in ICDs.
        3. Assure that all other settings of the CIED are appropriate.

Clinical Algorithm(s)

None provided

Scope

Disease/Condition(s)

Diseases or conditions requiring anesthesia care in patients with cardiac implantable electronic devices

Guideline Category

Diagnosis

Evaluation

Management

Clinical Specialty

Anesthesiology

Cardiology

Critical Care

Emergency Medicine

Nursing

Surgery

Intended Users

Advanced Practice Nurses

Health Care Providers

Nurses

Physicians

Guideline Objective(s)

- To facilitate safe and effective perioperative management of the patient with a cardiac implantable electronic devices (CIED)
- To reduce the incidence of adverse outcomes

Target Population

Patients with cardiac implantable electronic devices

Interventions and Practices Considered

Evaluation/Assessment

1. Preoperative evaluation
    - Establishing whether a patient has a cardiac rhythm management device (CIED)
    - Focused history (patient interview, medical records review, and review of available chest x-rays, electrocardiograms, or any available monitor or rhythm strip information)
    - Focused physical examination (check for scars and palpate for device)
    - Defining the type and function of CIED
    - Obtaining manufacturer's identification card from patient or other source
    - Ordering chest x-ray if no other data are available
    - Reference to supplemental resources (e.g., manufacturer's databases)
    - Determination of the dependence on pacing function of the CIED
    - Determination of CIED function
2. Preoperative preparation
    - Determining whether electromagnetic interference (EMI) is likely to occur during the planned procedure

Management

1. Intraoperative management
    - Monitoring operation of the CIED
    - Management of specific procedures (electrocautery, radiofrequency [RF] ablation, lithotripsy, magnetic resonance imaging, radiation therapy, electroconvulsive therapy, emergency defibrillation or cardioversion)
2. Postoperative management
    - Continuous monitoring of cardiac rate and rhythm
    - Ensuring immediate availability of back-up pacing and defibrillation equipment
    - Interrogation and restoration of CIED function and settings in the immediate postoperative period

Major Outcomes Considered

- Hypotension
- Tachyarrhythmia or bradyarrhythmia
- Myocardial tissue damage
- Myocardial ischemia or infarction

- Extended hospital stay
- Delay or cancellation of surgery
- Readmission to manage device malfunction
- Additional hospital resource utilization and cost

Methodology

Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

State of the Literature

For this updated Advisory, a review of the studies used in the development of the original Advisory and published after 1990 were combined with studies published subsequent to approval of the original Advisory. The updated literature review was based on evidence linkages, consisting of directional statements about relationships between specific perioperative management activities and cardiac implantable electronic devices (CIED) function or clinical outcomes.

For the literature review, potentially relevant studies were identified via electronic and manual searches of the literature. The updated electronic search covered a 7-yr period from 2004 to 2010. The manual search covered a 21-yr period of time from 1990 to 2010. Because CIEDs represent a rapidly changing technology, previous literature (i.e., literature published before 1990) was rarely included in the evaluation of evidence for this Practice Advisory. More than 300 citations that addressed topics related to the evidence linkages were initially identified. These articles were reviewed and combined with pre-2004 articles used in the original Advisory, resulting in a total of 134 articles that contained direct linkage-related evidence. There was no sufficient literature with we ll-defined experimental designs and statistical information to conduct an analysis of aggregated studies (i.e., meta-analysis) contained in the evidence linkage. A complete bibliography used to develop this updated Advisory, organized by section, is available as Supplemental Digital Content 1, http://links.lww.com/ALN/A656 .

Number of Source Documents

A total of 134 articles contained direct linkage-related evidence.

Methods Used to Assess the Quality and Strength of the Evidence

Expert Consensus

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Preparation of this update used the same methodological process as used in the original Advisory to obtain new scientific evidence. Opinion-based evidence obtained from the original Advisory is reported in this update. The protocol for reporting each source of evidence is described below.

Scientific Evidence

Study findings from published scientific literature were aggregated and are reported in summary form by evidence category, as described below. All literature (e.g., randomized controlled trials, observational studies, and case reports) relevant to each topic was considered when evaluating the findings. However, for reporting purposes in this document, only the highest level of evidence (i.e., levels 1, 2, or 3 identified below) within each category (i.e., A, B, or C) is included in the summary.

Category A: Supportive Literature. Randomized controlled trials report statistically significant ($P < 0.01$) differences between clinical interventions for a specified clinical outcome.

Level 1. The literature contains multiple, randomized controlled trials, and the aggregated findings are supported by meta-analysis.*

Level 2. The literature contains multiple, randomized controlled trials, but there is an insufficient number of studies to conduct a viable meta-analysis for the purpose of this Advisory.

Level 3. The literature contains a single, randomized controlled trial.

Category B: Suggestive Literature. Information from observational studies permits inference of beneficial or harmful relationships among clinical interventions and clinical outcomes.

Level 1. The literature contains observational comparisons (e.g., cohort, case-control research designs) of clinical interventions or conditions and indicates statistically significant differences between clinical interventions for a specified clinical outcome.

Level 2. The literature contains noncomparative observational studies with associative (e.g., relative risk and correlation) or descriptive statistics.

Level 3. The literature contains case reports.

Category C: Equivocal Literature. The literature cannot determine whether there are beneficial or harmful relationships among clinical interventions and clinical outcomes.

Level 1. Meta-analysis did not find significant differences among groups or conditions.

Level 2. There is an insufficient number of studies to conduct meta-analysis, and (1) randomized controlled trials have not found significant differences among groups or conditions or (2) randomized controlled trials report inconsistent findings.

Level 3. Observational studies report inconsistent findings or do not permit inference of beneficial or harmful relationships.

Category D: Insufficient Evidence from Literature. The lack of scientific evidence in the literature is described by the following terms:

Silent. No identified studies address the specified relationships among interventions and outcomes.

Inadequate. The available literature cannot be used to assess relationships among clinical interventions and clinical outcomes. The literature either does not meet the criteria for content as defined in the Focus of the Advisory or does not permit a clear interpretation of findings because of methodological concerns (e.g., confounding in study design or implementation).

*Practice advisories lack the support of a sufficient number of adequately controlled studies required to conduct an appropriate meta-analysis. Therefore, category A1 evidence is not reported in this document.

Opinion-based Evidence

The original Advisory contained formal survey information collected from expert consultants, a random sample of members of the American Society of Anesthesiologists (ASA), and a random sample of members of the Heart Rhythm Society (HRS). Additional information was obtained from open-forum presentations and other invited and public sources. All opinion-based evidence relevant to each topic (e.g., survey data, open-forum testimony, Internet-based comments, letters, and editorials) was considered in the development of the original Advisory.

Survey responses from Task Force–appointed expert consultants are reported in summary form in the text, with a listing of consultant survey responses reported in appendix 3 of the original guideline document. In addition, survey responses from active ASA and HRS members are reported in summary form in the text, with a listing of survey responses reported in appendix 3 of the original guideline document.

Methods Used to Analyze the Evidence

Meta-Analysis

Other

Systematic Review

Description of the Methods Used to Analyze the Evidence

State of the Literature

For this updated Advisory, a review of the studies used in the development of the original Advisory and published after 1990 were combined with studies published subsequent to approval of the original Advisory. The updated literature review was based on evidence linkages, consisting of directional statements about relationships between specific perioperative management activities and cardiac implantable electronic device (CIED) function or clinical outcomes. For the literature review, potentially relevant studies were identified via electronic and manual searches of the literature. The updated electronic search covered a 7-yr period from 2004 to 2010. The manual search covered a 21-yr period of time from 1990 to 2010. Because CIEDs represent a rapidly changing technology, previous literature (i.e., literature published before 1990) was rarely included in the evaluation of evidence for this Practice Advisory. More than 300 citations that addressed topics related to the evidence linkages were initially identified. These articles were reviewed and combined with pre-2004 articles used in the original Advisory, resulting in a total of 134 articles that contained direct linkage-related evidence. There was no efficient literature with well-defined experimental designs and statistical information to conduct an analysis of aggregated studies (i.e., meta-analysis) contained in the evidence linkage. A complete bibliography used to develop this updated Advisory, organized by section, is available as Supplemental Digital Content 1, http://links.lww.com/ALN/A656.

For the original Advisory, an interobserver agreement among Task Force members and two methodologists was established by interrater reliability testing. Agreement levels using a kappa (k) statistic for two-rater agreement pairs were as follows: (1) type of study design, k = 0.72 to 0.90; (2) type of analysis, k = 0.80 to 0.90; (3) evidence linkage assignment, k = 0.84 to 1.00; and (4) literature inclusion for database, k = 0.70 to 1.00. Three-rater chance-corrected agreement values were as follows: (1) study design, Sav = 0.81, Var (Sav) = 0.010; (2) type of analysis, Sav = 0.86, Var (Sav) = 0.009; (3) linkage assignment, Sav = 0.82 Var (Sav) = 0.005; and (4) literature database inclusion Sav = 0.78 Var (Sav) =0.031. These values represent moderate-to-high levels of agreement.

Consensus-based Evidence

For the original Advisory, consensus was obtained from multiple sources, including (1) survey opinions from consultants who were selected based on their knowledge or expertise in perioperative management of CIEDs, (2) survey opinions from randomly selected samples of active members of the American Society of Anesthesiologists and active members of the Heart Rhythm Society, (3) testimony from attendees of two publicly-held open forums at a national anesthesia meeting and at a major cardiology meeting, (4) Internet commentary, and (5) Task Force opinion and interpretation. The survey rate of return was 56% (n =23/41) for consultants, 15% (n = 89/600) for the ASA membership, and 15% (n = 44/300) for the HRS membership (see tables 3 and 4 in the original guideline document).

For the original Advisory, an additional survey was sent to the consultants asking them to indicate which, if any, of the evidence linkages would change their clinical practices if the Advisory was instituted. The rate of return was 39% (n = 16/41). The percent of responding consultants expecting no change associated with each linkage were as follows: preoperative evaluation, 67%; preoperative patient preparation, 67%; intraoperative monitoring of CIEDs, 67%; emergency defibrillation or cardioversion, 87%; postoperative monitoring of CIEDs, 73%; postoperative interrogation and restoration of CIED function, 60%; and intraoperative management of EMI during electrocautery, 73%; radiofrequency ablation, 73%; lithotripsy, 80%; MRI, 80%; radiation therapy, 80%; and electroconvulsive therapy, 73%. Forty percent of the respondents indicated that the Advisory would have *no effect* on the amount of time spent on a typical case. Nine respondents (60%) indicated that there would be an increase in the amount of time they would spend on a typical case with the implementation of this Advisory. The amount of increased time anticipated by these respondents ranged from 5 to 30 minutes.

Methods Used to Formulate the Recommendations

Expert Consensus

Description of Methods Used to Formulate the Recommendations

The original Advisory was developed by an American Society of Anesthesiologists (ASA)-appointed task force of 12 members, consisting of anesthesiologists and cardiologists in private and academic practices from various geographic areas of the United States and two methodologists from the ASA Committee on Standards and Practice Parameters.

The Task Force developed the original Advisory by means of a six-step process. First, they reached consensus on the criteria for evidence. Second, original published articles from peer-reviewed journals relevant to the perioperative management of cardiac rhythm management devices were evaluated. Third, consultants who had expertise or interest in CIEDs and who practiced or worked in various settings (e.g., private and

academic practice) were asked to (1) participate in opinion surveys on the effectiveness of various perioperative management strategies and (2) review and comment on a draft of the Advisory developed by the Task Force. Fourth, additional opinions were solicited from random samples of active members of both the ASA and the Heart Rhythm Society (HRS).* Fifth, the Task Force held an open forum at a national anesthesia meeting and at a major cardiology meeting to solicit input on the key concepts of this Advisory.** Sixth, all available information was used to build consensus within the Task Force to finalize the Advisory.

In 2009, the ASA Committee on Standards and Practice Parameters requested that scientific evidence for this Advisory be updated. The update consists of an evaluation of literature that includes new studies obtained after publication of the original Advisory.

*Formerly North American Society of Pacing and Electrophysiology (NASPE).

**International Anesthesia Research Society; 78th Clinical and Scientific Congress, March 28, 2004, in Tampa, Florida, and NASPE Heart Rhythm Society Annual Meeting, May 20, 2004, in San Francisco, California.

Rating Scheme for the Strength of the Recommendations

Not applicable

Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

External Peer Review

Internal Peer Review

Description of Method of Guideline Validation

Consultants who had expertise or interest in cardiac rhythm management devices (CIEDs) and who practiced or worked in various settings (e.g., private and academic practice) were asked to (1) participate in opinion surveys on the effectiveness of various perioperative management strategies and (2) review and comment on a draft of the Advisory developed by the Task Force. Additional opinions were solicited from random samples of active members of both the American Society of Anesthesiologists (ASA) and the Heart Rhythm Society (HRS).

The Task Force held an open forum at a national anesthesia meeting and at a major cardiology meeting to solicit input on the key concepts of this Advisory. All available information was used to build consensus within the Task Force to finalize the Advisory.

This Practice Advisory was approved by the ASA House of Delegates on October 20, 2010.

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

Evidence was obtained from two principal sources: scientific evidence and opinion-based evidence.

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Optimal patient perioperative management and reduction of adverse patient outcomes associated with cardiac implantable electronic devices

Potential Harms

- Adverse outcomes associated with a cardiac rhythm management device (CIED) include, but are not limited to, damage to the device, inability of the device to deliver pacing or shocks, lead-tissue interface damage, changes in pacing behavior, electrical reset to the backup pacing mode, or inappropriate implantable cardioverter-defibrillator (ICD) therapies. Inappropriate ICD therapy refers to the delivery of antitachycardia therapy (paced or shock) in the absence of a clinically indicated tachyarrhythmia. Inappropriate ICD therapy can harm a patient by inducing ischemia, worsening the arrhythmia, or causing the patient to move during a delicate procedure.
- Adverse clinical outcomes include, but are not limited to, hypotension, tachyarrhythmia or bradyarrhythmia, myocardial tissue damage, and myocardial ischemia or infarction. Other related outcomes may include extended hospital stay, delay or cancellation of surgery, readmission to manage device malfunction, or additional hospital resource utilization and cost.

Contraindications

Contraindications

Magnetic resonance imaging (MRI) is generally contraindicated for cardiac implantable electronic device (CIED) patients. If an MRI must be performed, consult with the ordering physician, the patient's pacemaker specialist or cardiologist, the diagnostic radiologist, and the CIED manufacturer.

Qualifying Statements

Qualifying Statements

- Practice advisories are systematically developed reports that are intended to assist decision-making in areas of patient care. Advisories are based on a synthesis of scientific literature and analysis of expert opinion, clinical feasibility data, open forum commentary, and consensus surveys. Advisories developed by the American Society of Anesthesiologists (ASA) are not intended as standards, guidelines, or absolute requirements, and their use cannot guarantee any specific outcome. They may be adopted, modified, or rejected according to clinical needs and constraints.
- The use of practice advisories cannot guarantee any specific outcome. Practice advisories summarize the state of the literature and report opinions obtained from expert consultants and ASA members. Practice advisories are not supported by scientific literature to the same degree as standards or guidelines because of the lack of sufficient numbers of adequately controlled studies. Practice advisories are subject to periodic revision as warranted by the evolution of medical knowledge, technology, and practice.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Implementation Tools

Resources

Staff Training/Competency Material

For information about availability, see the *Availability of Companion Documents* and *Patient Resources* fields below.

Institute of Medicine (IOM) National Healthcare Quality Report

Categories

IOM Care Need

Living with Illness

IOM Domain

Effectiveness

Safety

Identifying Information and Availability

Bibliographic Source(s)

American Society of Anesthesiologists. Practice advisory for the perioperative management of patients with cardiac implantable electronic devices: pacemakers and implantable cardioverter-defibrillators: an updated report by the American Society of Anesthesiologists Task Force [trunc]. Anesthesiology. 2011 Feb;114(2):247-61. [81 references] PubMed

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

2005 Jul (revised 2011 Feb)

Guideline Developer(s)

American Society of Anesthesiologists - Medical Specialty Society

Source(s) of Funding

American Society of Anesthesiologists

Guideline Committee

American Society of Anesthesiologists Committee on Standards and Practice Parameters

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Financial Disclosures/Conflicts of Interest

Not stated

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Cardiac Rhythm Management Devices. Practice advisory for the perioperative management of patients with cardiac rhythm management devices: pacemakers and implantable cardioverter-defibrillators: a report by the American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Cardiac Rhythm Management Devices. Anesthesiology. 2005 Jul;103(1):186-98.

Guideline Availability

Electronic copies: Available in Portable Document Format (PDF) and EPUB for eBook devices from the Anesthesiology Journal Web site .

Print copies: Available from the American Society for Anesthesiologists, 520 North Northwest Highway, Park Ridge, IL 60068-2573.

Availability of Companion Documents

A Continuing Medical Education (CME) course is available from the Anesthesiology Journal Web site .

Patient Resources

None available

NGC Status

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